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PRINCIPALS
Robert J. Michaud, P.E.
Ronald D. Desrosiers, P.E., PTOE
Daniel J. Mills, P.E., PTOE

MEMORANDUM

DATE: August 2, 2016

TO: Mr. Ron Lopez
North Shore Residential Development, Inc.
215 Salem Street
Woburn, MA 01801

FROM: Daniel J. Mills, P.E., PTOE - Principal
Daniel C. Lindquist – Transportation Engineer

RE: **Proposed Residential Development – Grove Street**
Lexington, Massachusetts

MDM Transportation Consultants, Inc. (MDM) has prepared this traffic impact assessment (TIA) for a proposed residential development to be located on Grove Street in Lexington, Massachusetts. This memorandum describes existing (baseline) traffic conditions for adjacent roadways, trip generation characteristics of the proposed development, quantifies incremental traffic impacts of the site development on area roadways, and evaluates safety-related conditions at key study locations that provide access to the site.

Key findings of the traffic assessment are as follows:

- *Baseline Traffic Volumes.* The weekday daily traffic volume on Grove Street adjacent to the Site is approximately 5,700 vehicles per day (vpd) on a weekday. Peak hour traffic flow on Grove Street ranges from approximately 515 to 598 vehicles per hour (vph) representing approximately 11 to 16 percent of daily traffic flow. Vehicle flow is heavily skewed in the southbound direction during the weekday morning peak hour and northbound during the weekday evening peak hour. The travel patterns are consistent with commuter traffic relative to major travel routes in the area.

- *Observed Travel Speeds.* A survey of travel speeds along Grove Street, adjacent to the proposed site driveways, using a radar recorder indicates 85th percentile speeds of 35 mph for the northbound travel direction and 34 mph for the southbound travel direction. The observed travel speeds are highly consistent with the posted (regulatory) speed limit of 30 mph on Grove Street in the study area.

- *Adequate Driveway Sight Lines.* Safe stopping sight distance (SSD) is available for oncoming vehicles to detect, react and stop for vehicles exiting the proposed site driveways onto Grove Street based on the regulatory speed limit and observed travel speeds. Likewise, the available ISD looking north and south from the proposed site driveways onto Grove Street exceed the recommended minimum sight line requirements.

- *Site Traffic Generation.* Based on industry standard trip rates and methodology published by the Institute of Transportation Engineers (ITE), the proposed development is estimated to generate approximately 224 weekday daily trips. Weekday peak hour trips are principally associated with commuter travel and are estimated to be 17 vehicle trips during the weekday morning peak hour and 21 vehicle trips during the weekday evening peak hour. Local trip rates developed from Town of Lexington traffic data from area residential uses validate the traffic projections.

- *Adequate Roadway Capacity & Operations.* The proposed site driveways along Grove Street will operate below capacity at LOS C or better during the weekday morning and weekday evening peak hours. The proposed residential development is not expected to materially impact operating conditions along Grove Street. The anticipated increase in total trips at the study intersections amounts to an additional 1 vehicle every 3 minutes or less during peak hours relative to No-Build conditions - a level that falls within normal day-to-day traffic fluctuation along Grove Street.

In summary, projected traffic increases due to the proposed development will be nominal in the immediate study area and adequate capacity is available under future Build conditions along Grove Street and at the study intersections to accommodate the proposed site use. The project is not projected to materially change any reported operating levels compared to future No-Build conditions, thus off-site mitigation are not warranted as a result of the project. Proposed access improvements, as outlined under *Conclusions and Recommendations*, will provide ample capacity to accommodate site-generated traffic while also enhancing safety and capacity. In addition, proposed access/egress along Grove Street will be designed to ensure that adequate sight lines are provided in accordance with minimum AASHTO criteria based on ambient travel speeds.

PROJECT DESCRIPTION

The project site is an approximate 10.58-acre tract of land located along Grove Street in Lexington, Massachusetts. The location of the site relative to adjacent roadways is shown in **Figure 1**. The site is currently undeveloped.

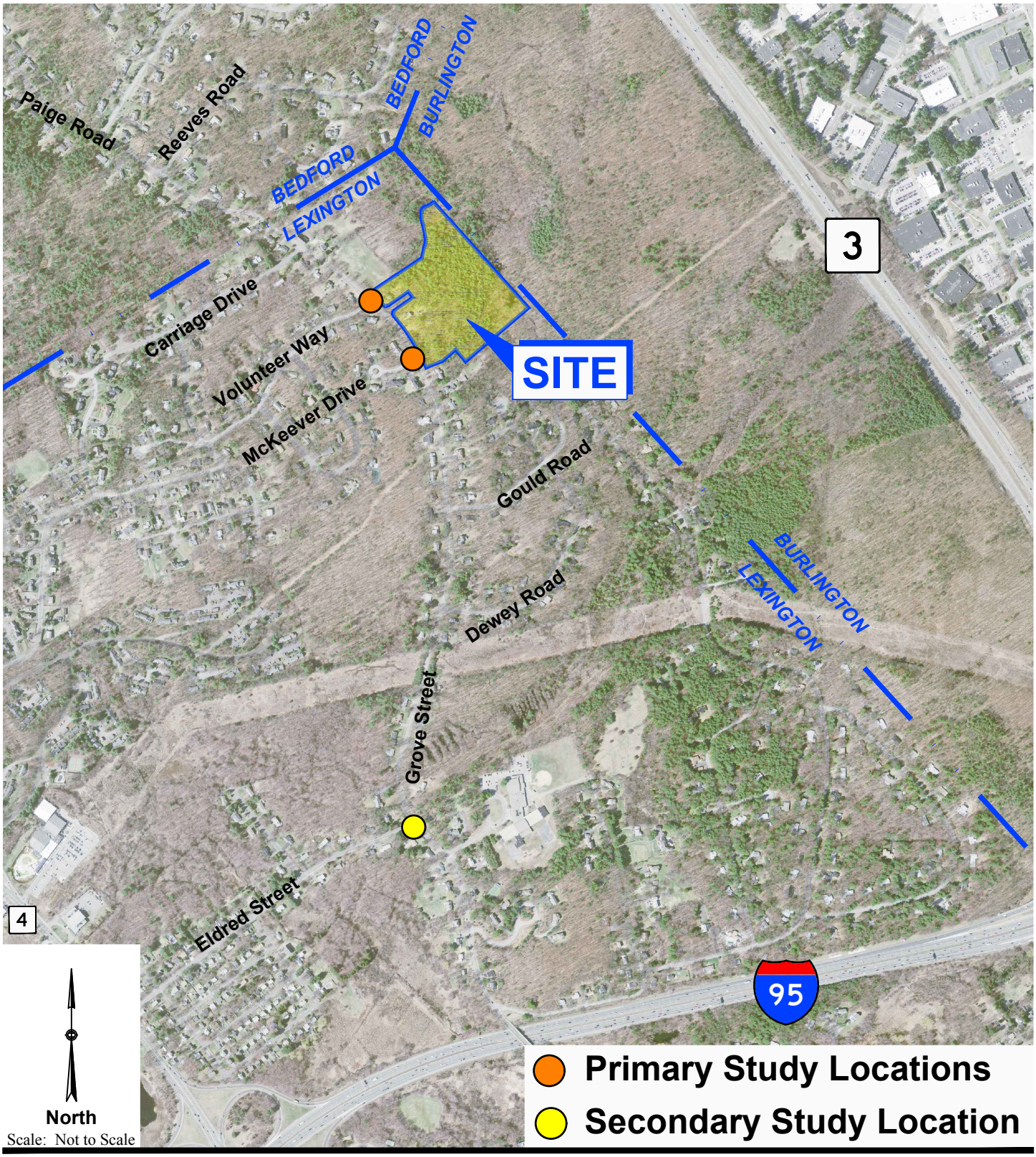

Figure 1

Site Location

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Date: August 2016

Under the proposed development plan, up to 36 residential townhouses will be constructed. Driveways and on-street parking will be provided for resident and visitor use. The development will be supported by two full access/egress driveways along Grove Street. The preliminary site layout prepared by Weinmayer/Jay Assoc., Inc. is presented in **Figure 2**.

STUDY AREA

This TIA evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the site, and that are likely to sustain a measurable level of traffic impact from the development. The study area includes the following primary intersections, which are also identified in **Figure 1**:

Primary Intersections

- Grove Street at Volunteer Way (Unsignalized)
- Grove Street at McKeever (Unsignalized)

A summary of the expected traffic volume increase at the Grove Street/Eldred Street intersection from the proposed development is provided herein for informational purposes.

EXISTING TRAFFIC & SAFETY CHARACTERISTICS

An overview of existing roadway conditions, traffic volumes and safety characteristics is provided below.

Grove Street

Grove Street is classified by the Massachusetts Department of Transportation (MassDOT) as an Urban Minor Arterial roadway under Town jurisdiction within the study area. Grove Street is generally a north-south roadway in the project area which provides a connection between Burlington Street to the south and Page Road, in Bedford, to the north. The roadway provides a single travel lane in each direction with paved shoulders and street lighting is provided in the site area. The regulatory (posted) speed limit in the project area is 30 mph in both travel directions. In the immediate project area, a bituminous concrete sidewalk is provided on the eastern side of the roadway. Land use along Grove Street is primarily single family residential homes but also includes Wrigley Farm, and conservation area.

Grove Street at Volunteer Way

Grove Street meets Volunteer Way to form a three-way, unsignalized intersection. All approaches to the intersection provide a single travel lane. The Volunteer Way eastbound approach to the intersection is under "STOP" sign control. Land uses at the intersection consist of single family homes.

North
Scale: Not to Scale

Site Plan Source: Sullivan Engineering & Weinmayr/Jay Associates

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Figure 2

Preliminary Site Layout

Date: August 2016
Dwg No. 880 Figure 2.dwg

Grove Street at McKeever Drive

Grove Street meets McKeever Drive to form a three-way, unsignalized intersection. All approaches to the intersection provide a single travel lane. The McKeever Drive eastbound approach to the intersection is under "STOP" sign control. Land uses at the intersection consist of single family homes. In addition, an unmarked pedestrian trail located just north of McKeever Drive leads into the site.

Baseline Traffic Data

Traffic volume data was collected at the study area intersection during the weekday morning (7:00 AM - 9:00 AM) and weekday evening (4:00 PM – 6:00 PM) periods to coincide with peak traffic activity of the proposed use and the adjacent streets. Traffic data used in this evaluation was collected in June 2016 when local schools were in session. These data reflect above-average traffic conditions based on review of MassDOT permanent count station data for the area. Therefore, no adjustment (reduction) in observed traffic volumes was applied to present a conservative analysis. Traffic count data and MassDOT permanent count station data are provided in the **Attachments.** The weekday morning and weekday evening peak hour traffic volumes for the study intersections are shown in **Figure 3.**

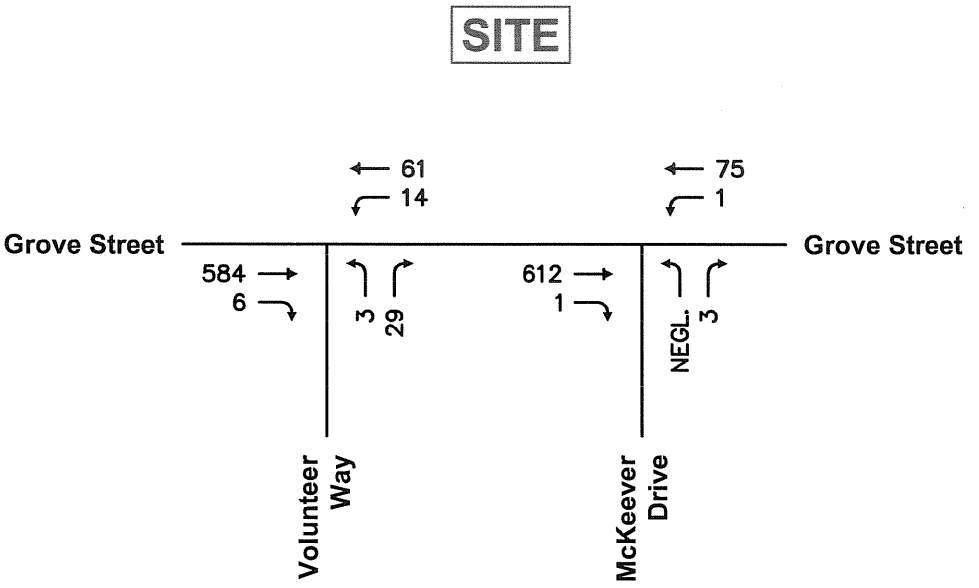
Daily Traffic Volumes

Daily traffic volumes along Grove Street in the site vicinity were obtained by mechanical methods using an automatic traffic recorder (ATR). The results of the counts are summarized in **Table 1**, and are discussed below.

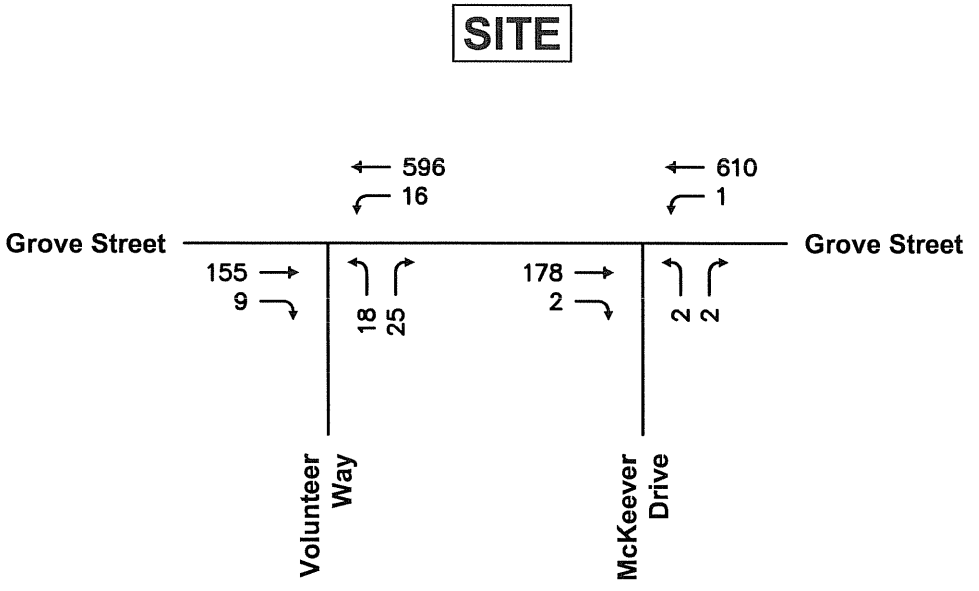
TABLE 1
EXISTING TRAFFIC VOLUME SUMMARY
GROVE STREET

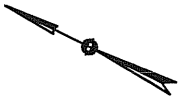
Time Period	Daily Volume (vpd)[1]	Percent Daily Traffic[2]	Peak Hour Volume (vph)[3]	Peak Flow Direction[4]	Peak Hour Directional Volume (vph)
Weekday Morning Peak Hour	5,700	11%	649	79% SB	515
Weekday Evening Peak Hour	5,700	16%	894	67% NB	598

[1]Two-way daily traffic expressed in vehicles per day without seasonal adjustment.
[2]The percent of daily traffic that occurs during the peak hour.
[3]Two-way peak-hour volume expressed in vehicles per hour.
[4]NB = Northbound, SB = Southbound



Weekday Morning Peak Hour





North
Schematic Not to Scale

NOTES:
NEGL. = Negligible

Weekday Evening Peak Hour

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Figure 3

2016 Baseline Conditions

Date: August 2016
Dwg No. 880 TIAS.dwg

As summarized in **Table 1,** the weekday daily traffic volume on Grove Street in the site vicinity is approximately 5,700 vehicles per day (vpd) on a weekday. Peak hour traffic flow on Grove Street ranges from approximately 649 to 894 vehicles per hour (vph) representing approximately 11 to 16 percent of daily traffic flow. Vehicle flow is heavily skewed in the southbound direction during the weekday morning peak hour and northbound direction during the weekday evening peak hour. The travel patterns are consistent with commuter traffic relative to major travel routes in the area.

Measured Travel Speeds

Vehicle speeds were obtained for the Grove Street northbound and southbound travel directions using an ATR machine equipped with speed radar. **Table 2** summarizes the regulatory posted speed limit and observed average and 85th percentile travel speeds for Grove Street adjacent to the Site. This speed data provides a basis for determining appropriate sight lines for the proposed driveways. Field data are provided in the **Attachments**.

TABLE 2
SPEED STUDY RESULTS – GROVE STREET

		Travel Speed	
Travel Direction	Posted Speed Limit	Average[1]	85th Percentile[2]
Northbound	30	30	35
Southbound	30	29	34

[1] Arithmetic Mean.
[2] The speed at or below which 85 percent of the vehicles are traveling.

As summarized in **Table 2**, the mean (average) travel speed on Grove Street in the site vicinity is 30 mph traveling northbound and 29 mph travelling southbound. The 85th percentile travel speed was observed to be 35 mph for the northbound travel direction and 34 mph for the southbound travel direction. The observed travel speeds are highly consistent with the posted (regulatory) speed limit of 30 mph on Grove Street in the study area.

Intersection Crash History

In order to identify crash trends and safety characteristics for study area intersections, crash data were obtained from MassDOT for the Town of Lexington for the four-year period 2010 through 2014 (the most recent data currently available from MassDOT) for the study intersections. Upon detailed review of the crash data, one crash occurred in the area of McKeever Drive during the four-year period. The crash appeared to have included a single-vehicle traveling northbound on Grove Street under foggy wet conditions, resulting in a property damage only type collision with a tree. No other crashes were reported during this time period. Based on our review of the reported, no immediate safety countermeasures are warranted at the study intersections.

Public Transportation Facilities

The Lexpress operates a bus route in the immediate study area that could be used as an alternative mode of travel to/from the Site. Specifically, Lexpress Bus Route 6 provides service between Depot Square and Grove Street via Hancock Street, Grove Street, Turning Mill Road and Massachusetts Avenue. Flag-down service is provided along Grove Street within the study. During the school year this route is extended to Lexington High School. Specific route and schedule information is provided in the **Attachments**. Several connections to other bus routes in the service area are available and service is generally provided five (5) days a week.

As a conservative measure, no credit (reduction) in site trips was taken as a result of the available public transportation services.

Sight Line Evaluation

An evaluation of sight lines was conducted at the proposed site driveway locations to ensure that minimum recommended sight lines are available at the proposed site driveway intersections with Grove Street. The evaluation documents sight lines under proposed conditions for vehicles as they relate to Grove Street with comparison to recommended guidelines.

The American Association of State Highway and Transportation Officials' (AASHTO) standards[1] reference two types of sight distance which are relevant at the proposed site driveway intersections along Grove Street: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the proposed site driveway intersections with Grove Street were compared to minimum SSD and ISD recommendations for the regulatory speed limit posted in the area as well as ambient travel speeds recorded along Grove Street in the immediate vicinity of the Site.

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[1] *A policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials (AASHTO), 2011.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near a regulatory speed limit, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting onto Grove Street. The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet level pavement. Adjustment factors are applied to account for roadway grades when applicable.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the northbound and southbound Grove Street approaches to the proposed site driveways. **Table 3** presents a summary of the available SSD as they relate to Grove Street and AASHTO's recommended SSD based on posted and observed ambient travel speeds along Grove Street.

TABLE 3
STOPPING SIGHT DISTANCE SUMMARY
GROVE STREET APPROACHES TO SITE DRIVEWAYS

Approach/ Travel Direction	Available SSD	AASHTO Recommended[1]	
		Regulatory Speed[2]	85th Percentile Travel Speed[3]
Grove Street at Northern Site Driveway			
Northbound	440± Feet	200 Feet	250 Feet
Southbound	>500 Feet	190 Feet	240 Feet
Grove Street at Southern Site Driveway			
Northbound	>500 Feet	190 Feet	235 Feet
Southbound	380± Feet	200 Feet	250 Feet

[1] Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet and adjustments for roadway grade if required
[2] Regulatory Speed Limit is 30 mph NB and SB
[3] 85th Percentile travel speed on Grove Street approximately 35 mph

As summarized in **Table 3,** analysis results indicate that the existing available sight lines exceed AASHTO's recommended SSD criteria for both travel directions along Grove Street. Stopping sight distance calculations are provided in the **Attachments.**

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. As stated under AASHTO's Intersection Sight Distance (ISD) considerations, "*...If the available sight distance for an entering ...vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to avoid collisions...To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road.*" AASHTO's ISD criteria are defined into several "cases". In this case, the proposed site driveway approaches to the intersection are proposed to be under "STOP"-sign control and the ISD in question relates to the ability to turn left or turn right onto Grove Street or travel across Grove Street onto McKeever Drive.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (8 to 14.5 feet from marked edge lines) for the northbound and southbound directions along Grove Street. **Table 4** presents a summary of the available ISD for the departure from the proposed site driveways and AASHTO's recommended ISD.

TABLE 4
INTERSECTION SIGHT DISTANCE SUMMARY
SITE DRIVEWAY DEPARTURES TO GROVE STREET

View Direction	Available ISD[1]	AASHTO Based Minimum ISD[2]	AASHTO Based Recommended ISD[3]
Grove Street at Northerly Site Driveway			
Looking North	>500 Feet	240 Feet	335 Feet
Looking South	460± Feet	250 Feet	290 Feet
Grove Street at Southerly Site Driveway			
Looking North	380± Feet	250 Feet	335 Feet
Looking South	340± Feet	235 Feet	290 Feet

[1] Based on AASHTO, A Policy on Geometric Design of Highways and Streets for driver height of eye of 3.5 feet and an object height of 3.5 feet. Assumes selective trimming and clearing of trees and vegetation and minor roadside regrading within the existing right-of-way of Grove Street.
[2] Minimum value as noted represents SSD for 85th percentile speed per AASHTO guidance.
[3] Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets for 30 mph posted regulatory speed limit.

The results of the ISD analysis presented in **Table 4** indicate that the available sight lines looking north and south from the proposed site driveways onto Grove Street will exceed the higher recommended sight distances with selective clearing and trimming of tress and re-grading associated with the installation of the site driveways. MDM recommends that any new plantings (e.g., shrubs, bushes) or physical landscape features (e.g., walls, signs, fencing) to be located within the driveway sight lines should also be maintained at a height of 2 feet or less above the adjacent existing roadway grade to ensure unobstructed lines of sight.

PROJECTED FUTURE TRAFFIC CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future baseline analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. For this evaluation, a five-year planning horizon (year 2021) was selected consistent with industry standard guidelines.

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), includes existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others that are currently under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop future Build conditions.

The following sections provide an overview of the future traffic volumes.

Background Growth

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

Nearby permanent count station data published by MassDOT indicates a declining (-0.2 percent per year) growth rate. For purposes of this evaluation, a 1.0 percent compounded annual growth rate was used (5.1 percent increase over a 5-year horizon). This growth rate is higher than historic rates, and, as such, is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with other potential small developments or vacancies in the area. MassDOT permanent count station data and background growth calculations are provided in the **Attachments.**

Development of future No-Build traffic volumes also considers traffic generated through the study area from other specific area developments. Review of Massachusetts Environmental Policy Act (MEPA) files and correspondence with the Town of Lexington indicate that there are currently no known permitted and unbuilt projects in the area that would significantly change baseline traffic volume conditions.

2021 No-Build Traffic Volume Networks

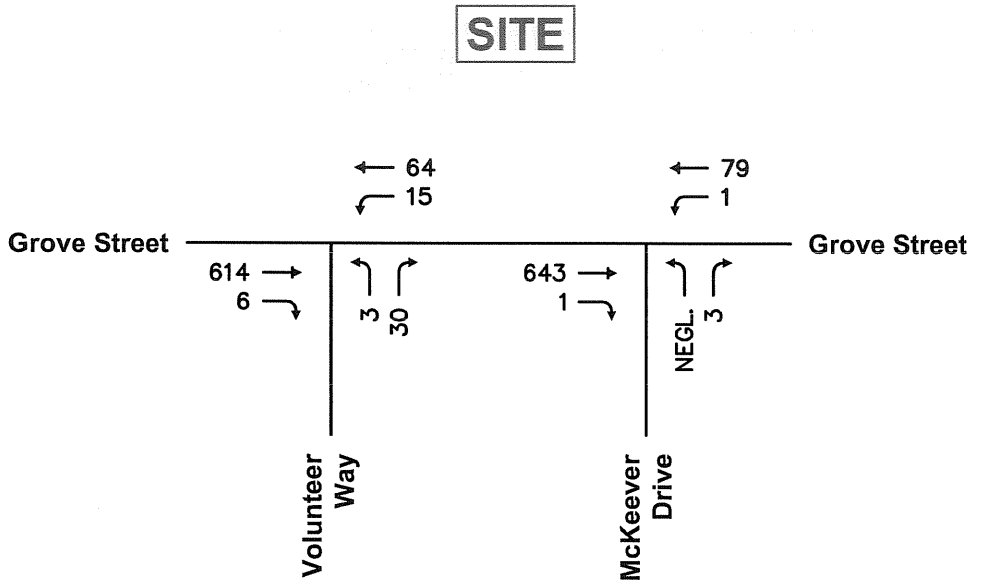
In summary, to account for future traffic growth in the study area, future No-Build traffic volumes are developed by increasing the existing (2016) volumes by approximately 5.1 percent (1-percent compounded annually over 5 years). The resulting 2021 No-Build traffic volumes are displayed in **Figure 4.**

Trip Generation

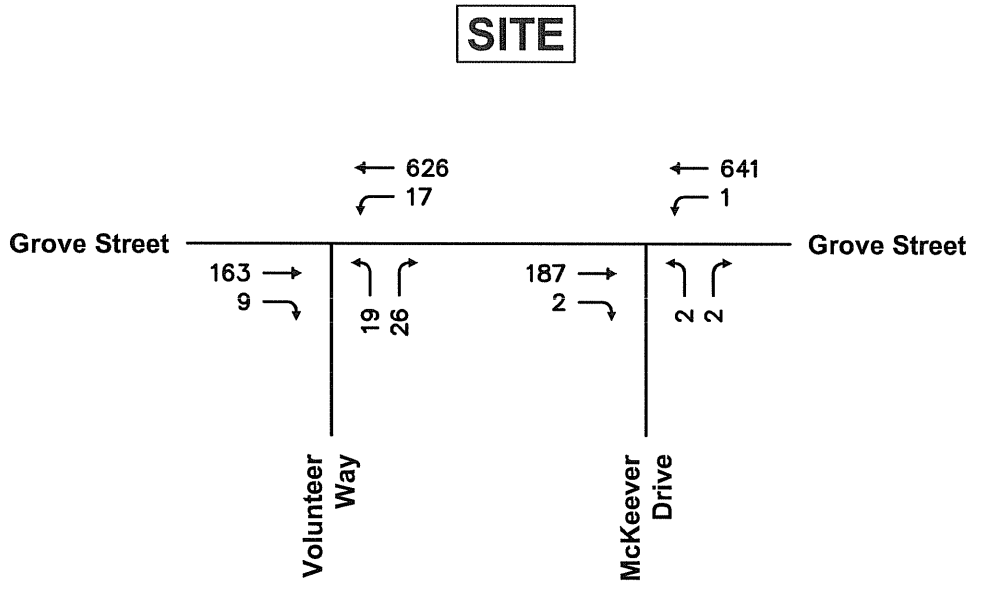
The trip generation estimates for the proposed development are provided for the weekday morning and weekday evening periods, which correspond to the critical analysis periods for the proposed uses and adjacent street traffic flow. New traffic generated by the project was estimated using trip rates published in ITE's *Trip Generation*[2] for the Land Use Code (LUC) 230 – Residential Condominium/Townhouse and Land Use Code (LUC) 210 – Single Family – Detached Housing. It should be noted that recent traffic count data collected by the Town of Lexington for a local residential neighborhood and a townhouse development exhibit similar trip generation rates as those compiled by ITE. Therefore, the ITE methodology used in this report is appropriate. A summary of ITE and local trip rates is provided in the **Attachments**.

Table 5 presents the trip-generation estimate for the proposed development based on ITE methodology.

[2]*Trip Generation,* Ninth Edition; Institute of Transportation Engineers; Washington, DC; 2012.



Weekday Morning Peak Hour



North
Schematic Not to Scale

NOTES:
NEGL. = Negligible

Weekday Evening Peak Hour

Figure 4

2021 No-Build Conditions

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TABLE 5
TRIP-GENERATION SUMMARY (36-Unit Development)[1]

Peak Hour/Direction	4 Single Family Units[2]	32 Townhouse Units[3]	Total Trips
Weekday Morning Peak Hour:			
Entering	1	2	**3**
Exiting	2	12	**14**
Total	3	14	**17**
Weekday Evening Peak Hour:			
Entering	3	11	**14**
Exiting	1	6	**7**
Total	4	17	**21**
Weekday Daily (24 hours)	38	186	**224**

[1]Source: ITE *Trip Generation*, Ninth Edition; 2012.
[2]ITE LUC 210 – Single Family – Detached Housing applied to 4 units.
[3]ITE LUC 230 – Residential Condominium/Townhouse applied to 32 units.

As summarized in **Table 5**, a 36-unit development is estimated to generate approximately 17 vehicle trips (3 entering and 14 exiting) during the weekday morning peak hour and 21 vehicle trips (14 entering and 7 exiting) during the weekday evening peak hour. On a daily basis, the development is estimated to generate approximately 224 vehicle trips on a weekday with 50 percent entering and exiting. After taking into account the directional distribution of site trips, this represents an approximate three percent (3%) increase in traffic on Grove Street, which carries 5,700± vehicles per day. Trip generation calculations are provided in the **Attachments**.

For comparison purposes, trip generation characteristics of the Site were also estimated for a 13-lot by-right residential subdivision and compared to the proposed development. Detailed ITE based trip generation worksheets are provided in the **Attachments** with results summarized in **Table 6**.

TABLE 6
TRIP-GENERATION COMPARISON (By-Right Use vs. Proposed Use)[1]

Peak Hour/Direction	Site Trips: By-Right Use (13-lot subdivision)[2]	Site Trips: Proposed Development (36-Units)[3]	Difference (Δ)[4]
Weekday Morning Peak Hour:			
Entering	3	3	0
Exiting	7	14	+7
Total	10	17	+7
Weekday Evening Peak Hour:			
Entering	8	14	+6
Exiting	5	7	+2
Total	13	21	+8
Weekday Daily (24 hours)	124	224	+100

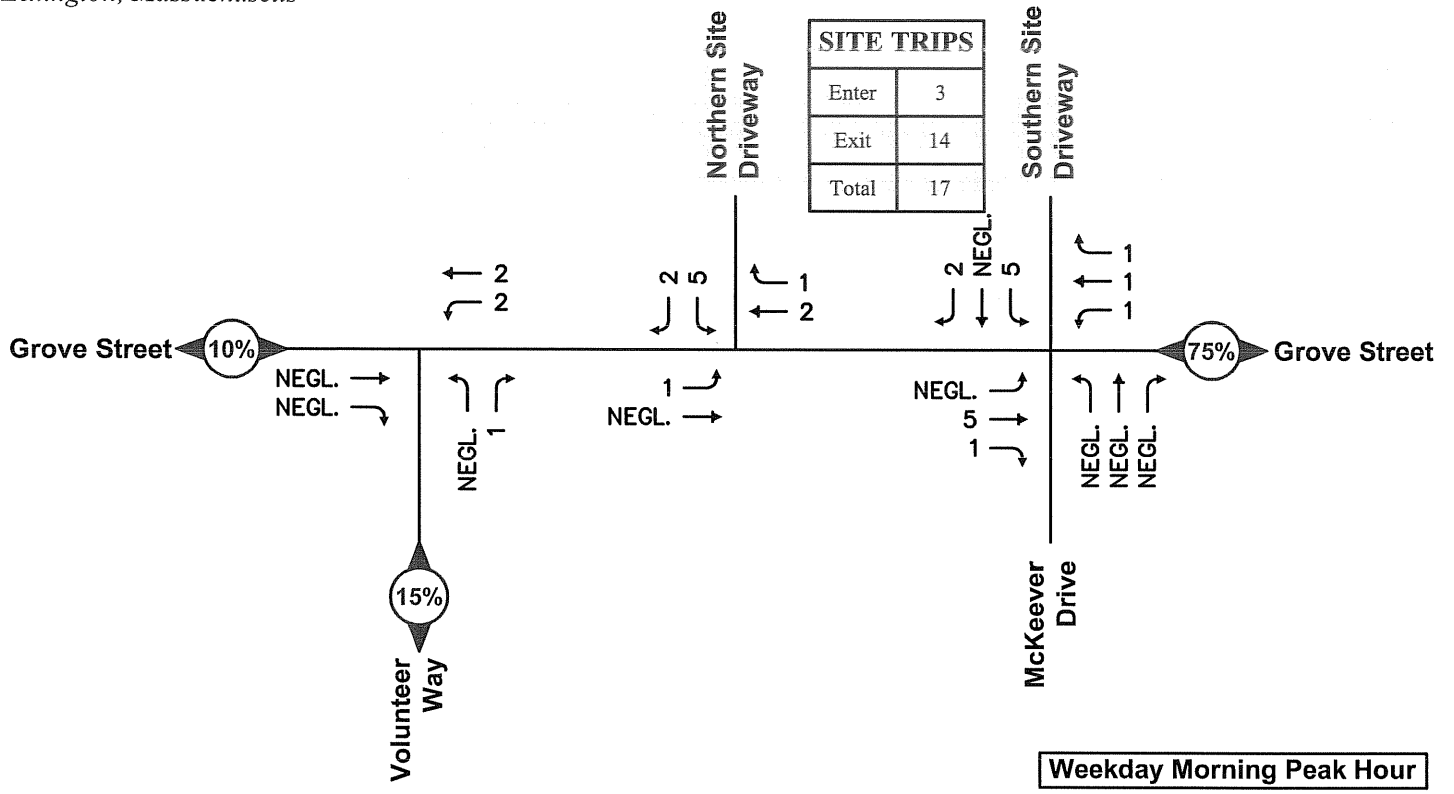
[1] Source: ITE *Trip Generation*, Ninth Edition; 2012.
[2] ITE LUC 210 – Single Family – Detached Housing applied to 13 units.
[3] ITE LUC 230 – Residential Condominium/Townhouse applied to 32 units and ITE LUC 210 – Single Family Detached Housing applied to 4 units

As summarized in **Table 6**, the by-right use of the Site is estimated to generate between 10 and 13 vehicle-trips during weekday morning and evening periods. The proposed use at the Site represents a minor seven to eight vehicle trip difference compared to a proposed 36-unit residential development which would not represent a significant change to traffic operations compared to the by-right use.

Trip Distribution

The distribution for projected traffic for the proposed residential development is based primarily on US Census journey-to-work data and existing travel patterns. Turn restriction at the Eldred Street/Bedford Road intersection and the location of the units along the internal site roadway were also considered. The resulting trip distribution for new trips is presented in **Figure 5**. Trip distribution calculations are provided in the **Attachments.**

Development-related trips for the proposed use are assigned to the roadway network using the ITE trip-generation estimates shown in **Table 5** and the distribution patterns presented in **Figure 5**. Development-related trip tracings at each intersection approach for the weekday morning and weekday evening peak hours are quantified in **Figure 5.**



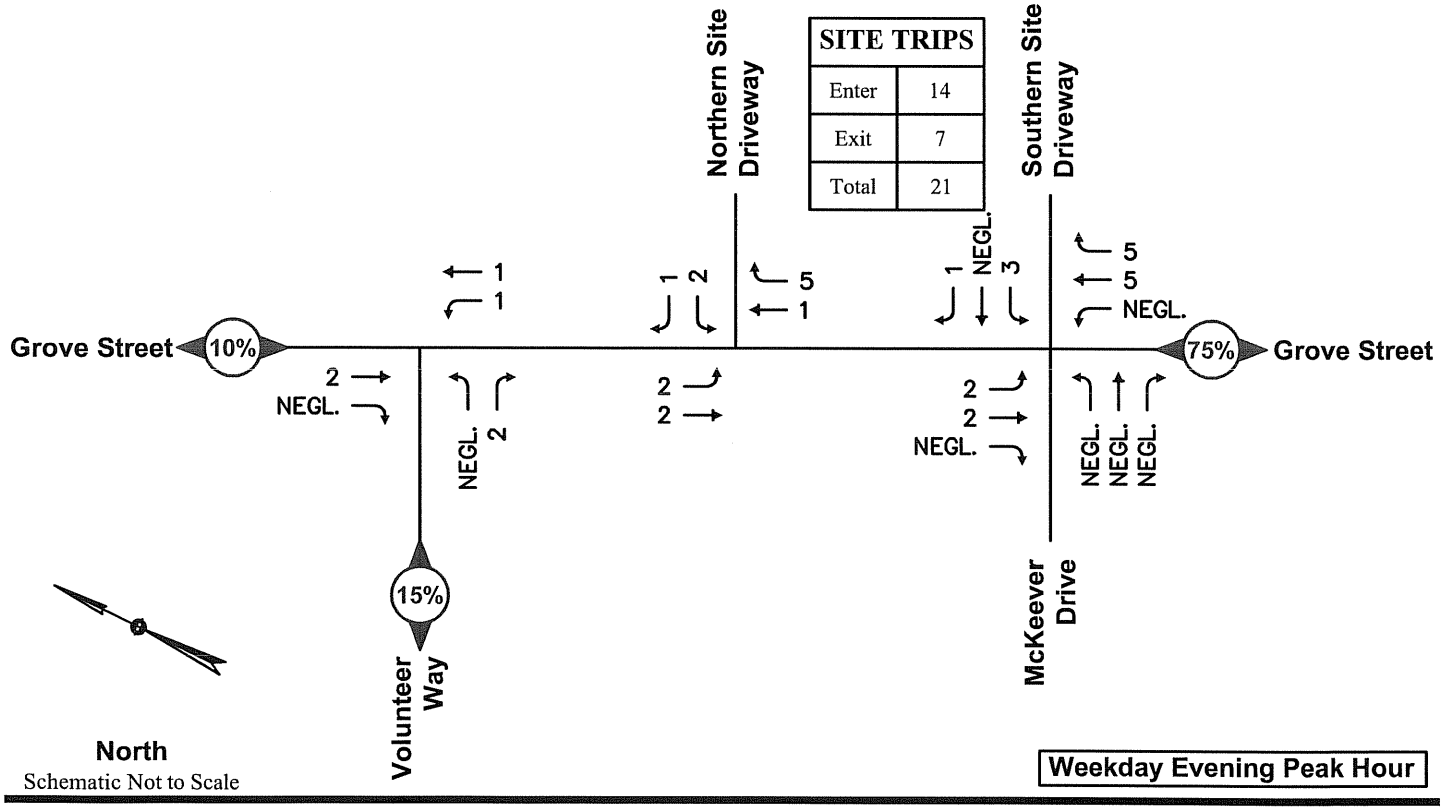


Figure 5

Site Generated Trips

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2021 Build Traffic Conditions

2021 Build condition traffic volumes are derived by adding the incremental traffic increases for the site to the 2021 No-Build conditions. **Figure 6** presents the 2021 Build condition traffic-volume networks for the weekday morning and weekday evening peak hours.

OPERATIONS ANALYSIS

This section provides an overview of operational analysis methodology, an assessment of driveway operations under existing (baseline) and projected future No-Build and Build conditions.

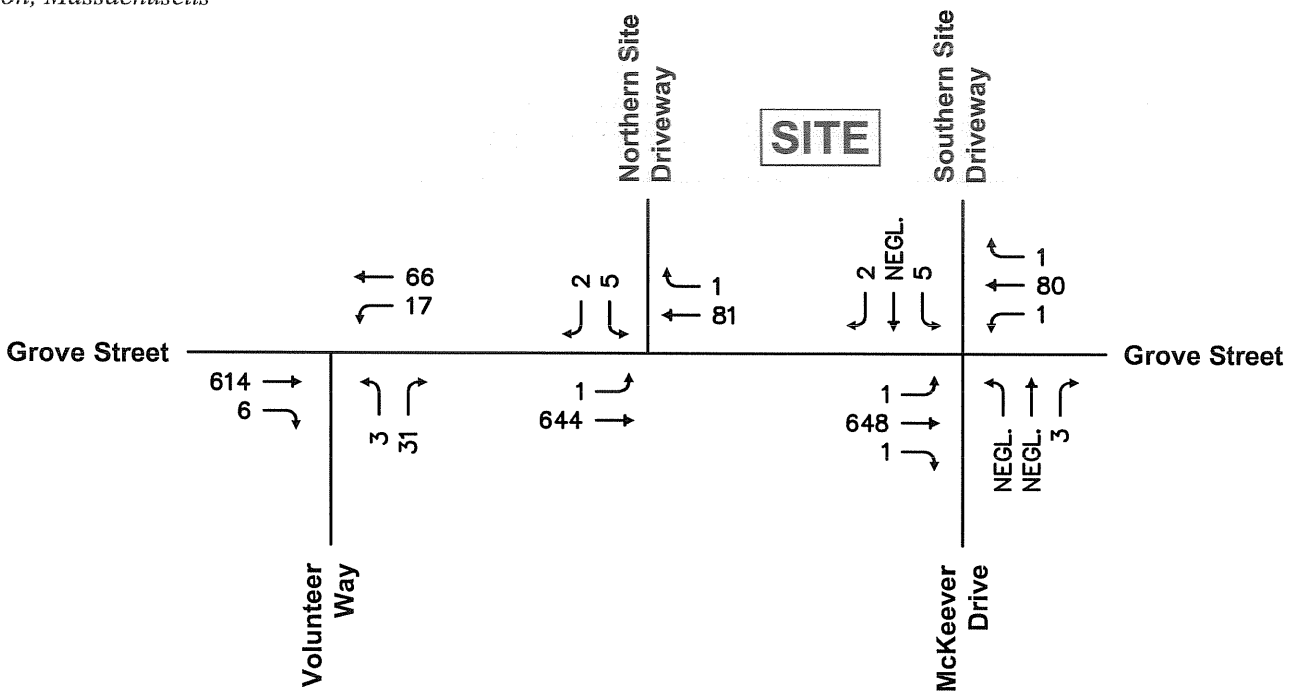
Analysis Methodology

Intersection capacity analyses are presented in this section for the Existing, No-Build, and Build traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them. The operational results provide the basis for recommended access and roadway improvements in the following section.

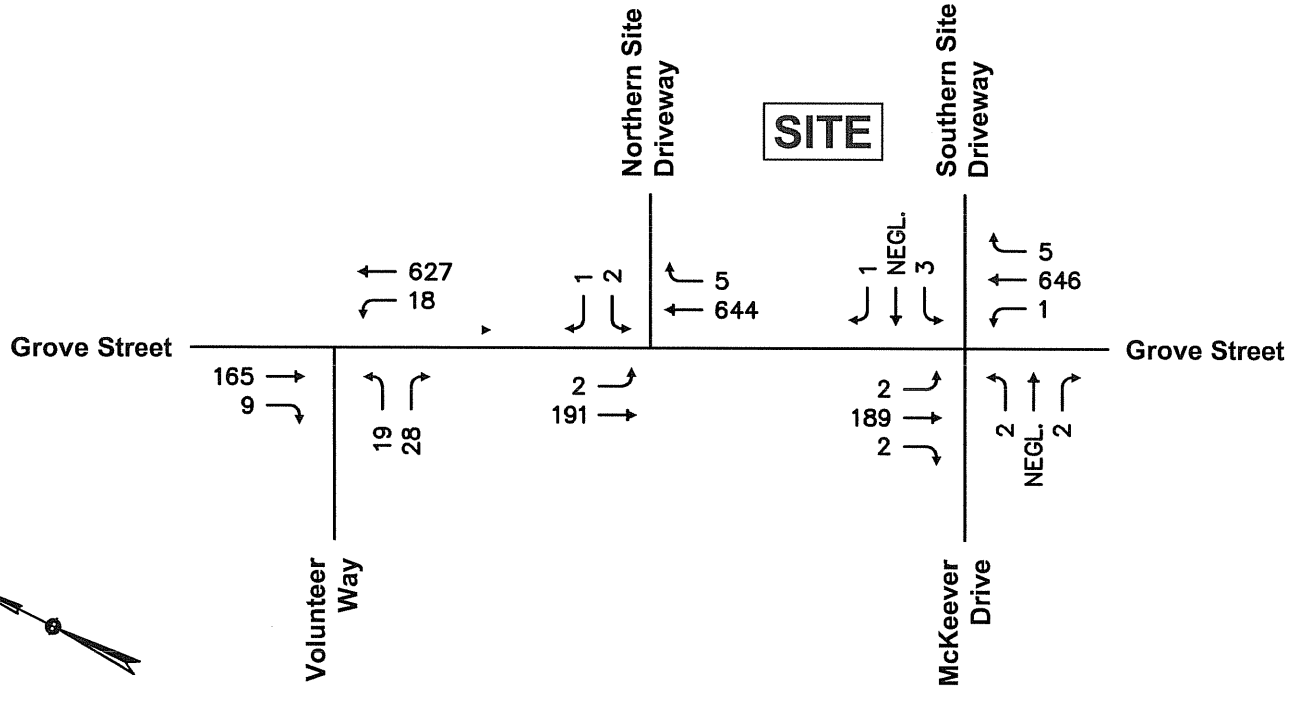
Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the 2010 Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements). The specific control delays and associated LOS designations are presented in the **Attachments**.

Analysis Results

Level-of-Service (LOS) analyses were conducted for the Existing, No-Build, and Build conditions for the study intersections. The results of the intersection capacity are summarized below in **Table 7** and **Table 8**. Detailed analysis results are presented in the **Attachments**.



Weekday Morning Peak Hour



North
Schematic Not to Scale

NOTES:
NEGL. = Negligible

Weekday Evening Peak Hour

Figure 6

2021 Build Conditions

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TABLE 7
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR

Period	Approach	2016 Existing			2021 No-Build			2021 Build		
		v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Grove Street at	Southbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Volunteer Way	Northbound	0.02	<5	A	0.02	<5	A	0.02	<5	A
	Eastbound	0.08	14	B	0.09	14	B	0.09	14	B
Grove Street at	Southbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
McKeever Drive/ Site	Northbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Driveway (Southern)	Eastbound	0.01	13	B	0.01	13	B	0.01	13	B
	Westbound	n/a	n/a	n/a	n/a	n/a	n/a	0.02	15	B
Grove Street at	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
Site Driveway (Northern)	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Westbound	n/a	n/a	n/a	n/a	n/a	n/a	0.02	13	B

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service

TABLE 8
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR

Period	Approach	2016 Existing			2021 No-Build			2021 Build		
		v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Grove Street at	Southbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Volunteer Way	Northbound	0.02	<5	A	0.02	<5	A	0.02	<5	A
	Eastbound	0.09	14	B	0.12	14	B	0.13	14	B
Grove Street at	Southbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
McKeever Drive/ Site	Northbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
Driveway (Southern)	Eastbound	0.01	13	B	0.01	14	B	0.01	16	C
	Westbound	n/a	n/a	n/a	n/a	n/a	n/a	0.02	20	C
Grove Street at	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
Site Driveway (Northern)	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Westbound	n/a	n/a	n/a	n/a	n/a	n/a	0.02	16	C

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service

As summarized in **Table 7** and **Table 8**:

- Under Build Conditions, the proposed site driveways along Grove Street will operate below capacity at LOS C or better during the weekday morning and weekday evening peak hours.

- With less than a five second increase in vehicle delay during peak hours, the proposed development is not expected to materially impact traffic operations at the Grove Street/Volunteer Way intersection.

- With less than a five second increase in vehicle delay during peak hours, the proposed development is not expected to materially impact traffic operations at the Grove Street/McKeever Drive intersection.

In summary, the proposed development is not expected to materially impact study area intersections and will not result in any material changes in traffic operations in the study area between future No-Build and Build conditions. Based on our review of intersection capacity, no off-site mitigation is warranted at the primary study locations.

Quantitative Impact – Secondary Location

A quantitative impact analysis was conducted for the secondary study intersection, Grove Street at Eldred Street. A summary of the peak hour traffic volume increases due to the proposed project is provided below in **Table 9**.

TABLE 9
TRAFFIC VOLUME SUMMARY (Grove Street at Eldred Street)
PEAK HOUR ENTERING TRAFFIC VOLUME

Time Period	Entering Intersection Volume		Increase
	2021 No-Build[2]	2021 Build[3]	(%)[4]
Weekday Morning Peak Hour	922	934	1.3%
Weekday Evening Peak Hour	894	909	1.7%

[1]Traffic volumes based on TMC data collected as part of this expressed in vehicles per hour.
[2]Estimated No-build entering intersection volume.
[3]Estimated Build entering intersection volume.
[4]Estimate percentage increase due to proposed site development.

In summary, the proposed development is not expected to materially impact the secondary study location and will not result in any material changes in traffic volumes conditions - a level that falls within normal day-to-day traffic fluctuation along Grove Street. Therefore, no off-site mitigation is warranted at the secondary study location.

REDUCED DEVELOPMENT SCENARIO

As stated in this report, up to 36 residential units are being contemplated for the Grove Street site. While the above traffic analyses indicates no significant traffic impacts for that level of development, trip generation estimates have been development for a reduced development scenario, that is, a 28-unit development consisting of five single-family homes and 23 townhouse units. A comparison of the trip generation estimated for a 13-lot by-right residential subdivision to the trip generation estimated for a 28-unit development, as shown in **Table 10**, indicates a similar level of traffic and therefore a similar level of traffic impact, if any, on the Grove Street study area.

TABLE 10
TRIP-GENERATION COMPARISON (By-Right Use vs. 28-Unit Development)[1]

	Site Trips		
Peak Hour/Direction	**By-Right Use (13-lot subdivision)[2]**	**Alternative Development (28-Units)[3]**	**Difference (Δ)[4]**
Weekday Morning Peak Hour:			
Entering	3	3	**0**
Exiting	7	11	**+4**
Total	10	14	**+4**
Weekday Evening Peak Hour:			
Entering	8	11	**+3**
Exiting	5	6	**+1**
Total	13	17	**+4**
Weekday Daily (24 hours)	124	182	**+58**

[1] Source: ITE *Trip Generation,* Ninth Edition; 2012.
[2] ITE LUC 210 – Single Family – Detached Housing applied to 13 units.
[3] ITE LUC 230 – Residential Condominium/Townhouse applied to 23 units and ITE LUC 210 – Single Family Detached Housing applied to 5 units

CONCLUSIONS AND RECOMMENDATIONS

The proposed residential development will generate approximately 17 vehicle trips during the weekday morning peak hour and 21 vehicle trips during the weekday evening peak hour. Local trip rates developed from Town of Lexington traffic data for area residential uses validate the traffic projections.

The proposed residential development is not expected to materially impact operating conditions along Grove Street. The site driveway approaches to Grove Street will operate at LOS C or better during the peak hours. With select trimming and clearing of trees during site construction, safe stopping sight distance (SSD) will be available for oncoming vehicles to detect, react and stop for vehicles exiting onto Grove Street from the proposed site driveways based on regulatory speed limits and observed travel speeds.

MDM recommends the following site access design elements to accommodate site-generated traffic while also enhancing safety along Grove Street:

- MUTCD compliant "STOP" signs (R1-1) and STOP line pavement markings are recommended on the driveway approaches to Grove Street.

- Existing and/or new plantings (shrubs, bushes) and structures (walls, fences, etc.) should be maintained at a height of 2 feet or less within the sight line triangles with respect to Grove Street to provide unobstructed sight lines for vehicles entering and exiting the unsignalized site driveways.